

DC Powering of IT Equipment Demonstration Meeting

Meeting Notes

August 4, 2005 Meeting at
Pentadyne Corp.
20750 Lassen St.
Chatsworth, CA 91311

Attendees:

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Purposes and goals of the meeting:

- ◆ Demonstration of Pentadyne flywheel UPS technology, and Baldwin Technologies Inc. DC powering unit
- ◆ Brainstorm DC powering issues and possible demonstrations
- ◆ Share LBNL CEC project information
- ◆ Secure industry partners

Overview:

The meeting involved experts in data center design and operation, UPS vendor, controls manufacturers, technology integrators, instrumentation manufacturers, and component suppliers. No data center end users were present, but several were represented by Baldwin Technologies. Several hours of lively discussion helped to identify potential industry partners, and brought out many issues and opportunities to address in the demonstration and eventual implementation.

The demonstration at the Pentadyne manufacturing facility successfully demonstrated the Pentadyne unit's ability to maintain constant (conditioned by the flywheel UPS) DC output even when upsets to the incoming power were experienced. In this demonstration

DC power was supplied at approximately 500 volts through commercially available components. The flywheel system maintains constant output at preset levels. The 500 VDC power is then converted to 48 VDC which can then be fed to the IT equipment. Depending upon the connected load, the flywheel will maintain this level for varying lengths of time. Baldwin Technologies supplied the DC delivery system, and Dranetz BMI supplied the monitoring instrumentation.

During the discussion which followed, the results from the Ecos Consulting and EPRI Solutions investigations into UPS and power supply efficiency were presented and a number of considerations to be accounted for in a demonstration project were discussed. Barriers to implementing this technology were also introduced from time to time. Issues discussed include:

- ◆ All major server manufacturers currently have DC products that operate on 48 VDC
- ◆ Telcom data centers typically operate on 48 VDC
- ◆ Commercially available equipment can be used for DC demonstration (no R&D required) including UL listed busbar to supply the server equipment.
- ◆ Sun has swappable AC or DC power supplies
- ◆ DC components are NEBS compliant making them more expensive
- ◆ The server manufacturers will always want to have control over the final conversion part of their equipment because of power quality/surge, safety, etc.
- ◆ Both H-P and Sun have data on relative performance of AC and DC powered machines. Sun claims not much difference.
- ◆ DC conversion is about as efficient as AC conversion
- ◆ Questions: Have we picked the best demonstration opportunity? Will it get implemented?
- ◆ Recommendation: Do a paper study first from an existing configuration to see what savings might be possible (or not). Look at losses in AC data center and then do the same for the DC. Study could use ranges of UPS performance from prior work.
- ◆ Computational capability going up faster than power: over 5 yr period 25 times increase in computational performance and performance per watt 6 times increase (per H-P)
- ◆ One possible demo (Mark Baldwin) – compare how much functionality you can get into a rack with AC vs DC
- ◆ Nextek has a multiple output DC source (DC router?) that may be able to play a big role
- ◆ Mark Baldwin claims 6-7 kW per rack is limit for air cooling (although ASHRAE has shown an 18 kW rack in air.
- ◆ Ave. rack today is 2-1/2 to 3 kW
- ◆ Data center user group sponsored by Emerson reports average of 60 W/sf - the group thought this was total including HVAC - if so it matches well with LBNL findings.

- ◆ Voltage discussion: What distribution voltage? 500; 380; 48 ? Today existing Sun power supplies can be changed out to run on 380 volts. IBM uses 350 volts. 380 appeared to be the current choice.
- ◆ Issue: Where does conversion take place and who owns it? Voltage conversions need to be optimized - can't be one big step down to 48 volts. Where will the energy savings come from?
- ◆ Issue: Sun shows ~75% efficiency for AC/DC but also ~75% efficiency for DC/DC converters when running servers at 48 V DC. If we want savings, the DC/DC must be optimized – obvious question is, why not do that for the AC/DC conversion? (Of course this overlooks the savings from elimination of UPS)
- ◆ Issue: Server manufacturers want their power source to be an integral part of the box – for safety, as well as to prevent others from plugging in. (This can be a common issue in data centers, if there is a source available, people will plug into it. If we hang a 500-48 VDC step down DC/DC converter near the rack, it will be a “target” for folks looking for plugs)
- ◆ Barriers:
 - different voltages today in servers and other IT equipment
 - safety concern above 150 volts
 - Above 60 volts - SELV classification
 - Developing a new standard for voltage distribution
- ◆ Constraints/criteria
 - No shut down to make changes
 - At least as reliable as present scheme
 - Cost- show money to the bottom line
 - Hot swappable
 - Could allow more servers (i.e. same load)
 - Life cycle cost justification/cost of ownership
 - MTBF study
- ◆ Possible host sites:
 - Visa - San Mateo, CA
 - DupontFabrose (?)
 - Concurrant (?)
 - Sun
- ◆ H-P and Sun will volunteer data

Next steps:

- ◆ Finalize a host site
- ◆ Consider paper study
- ◆ Visit H-P and Sun to see what data they can share
- ◆ Follow up with participants regarding details of demonstration